

"Express Mail" mailing label number EL 832 915 660 US
Date of Deposit January 16, 2002

NON-PROVISIONAL PATENT APPLICATION
Attorney Reference Number: 2665/5
(5nQ)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
APPLICATION FOR UNITED STATES LETTERS PATENT

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TITLE: METHOD AND SYSTEM FOR
TRANSFERRING INFORMATION BETWEEN
MULTIPLE BUYERS AND MULTIPLE
SELLERS

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2002 JAN 16 14 30 PM

METHOD AND SYSTEM FOR TRANSFERRING INFORMATION BETWEEN MULTIPLE BUYERS AND MULTIPLE SELLERS

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APPLICATION HISTORY

This Application claims the benefit of U.S. Provisional Patent Application,
Serial Number 60/262,182, filed on 17 January 2001 and entitled "Method and
10 System for Transferring Blood-Related Information Between Multiple Buyers and
Multiple Sellers of Blood," and U.S. Provisional Patent Application, Serial Number
60/262,184, filed on 17 January 2001 and entitled "Method and System for
Transferring Inventory Information Between Multiple Buyers and Multiple Sellers."

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FIELD OF THE INVENTION

The present invention generally relates to the field of information transfer
and, more specifically, to a method and system for transferring information
20 between multiple buyers and multiple vendors.

BACKGROUND OF INVENTION

25 Traditional inventory management systems were internally focused (i.e.,
only concerned about a particular customer or a particular vendor), and insight
into inventory on hand was limited to each party's own staff. As a result,
inventory management systems for both customers and vendors were limited to
managing current stock on hand and alerting responsible parties when to re-
30 order certain products. Any visibility into a customer's inventory level by a

vendor or a vendor's stocking level by a customer was established through a specific arrangement and proprietary computer system integration.

Another obstacle was that, in most vendors' and most customers' internal systems, inventory, production, sales management, billing, etc. were very often based on many separate computer systems. These systems lacked the standardization afforded by a common communicative language, one that would enable an efficient data exchange. Furthermore, this lack of standardization prevented not only vendors from proactively managing their customers, but also prevented different departments of the same customer from accurately viewing product stocking and consumption rates.

There is, therefore, a need to provide a method and system for transferring information between multiple buyers and multiple sellers that overcomes the above-stated disadvantages.

SUMMARY OF THE INVENTION

The present invention provides an industry-wide, multi-party inventory management system. The system of the present invention comprises a collective view of the inventory levels within an entire market while extending the "just in time" inventory practices of each manufacturer to the point of consumption through the deployment of "point of use" level data capture devices and a central database. Individually established product re-supply level points are used by the central database's operating system to trigger a vendor's re-supply and billing mechanisms. Licensed access by a manufacturer sales or service representative in the field, coupled with the use of similar data collection devices, enables the management of truck stock inventory and the corresponding product visibility with regard to location, type and disposition. Furthermore, the optimization of the product at the point of use is made possible by licensed access for a vendor and their ability to use the present invention and supporting

decision tools to move the necessary inventory to the optimal or immediate point of consumption. Since the needs of each customer is different, the present invention allows individual vendor and customer licensors to set mutually agreed-upon inventory levels which satisfy the operational requirement for each customer, while avoiding excessive stocking by either party.

The present invention is thus designed to invigorate and optimize the general commercial activities of participating industries. Beyond simple inventory consumption triggers and product level analysis, the present invention provides a platform for the easy collection and dissemination of a wide range of commerce-related information throughout an industry, without burdening any party with more than a single, direct interface to all other parties. Furthermore, intelligent controls limit access by each individual while mutually agreeable licensing agreements and syndicate arrangements allow each vendor and customer to control the expansion and participation of parties in the model.

BRIEF DESCRIPTION OF THE FIGURES

FIG. 1 is a schematic diagram of the current environment of an inventory management system;

FIG. 2 is a schematic diagram of one embodiment of an inventory management system, in accordance with the present invention;

FIG. 3 is a flow chart illustrating the basic function of the system of **FIG. 2**;

FIG. 4 is a flow chart illustrating the security and access control component of the system of **FIG. 2**;

FIG. 5 illustrates an array highlighting a dynamic creation of customized data sets, according to the system of **FIG. 2**;

FIG. 6 illustrates an example of a two-dimensional data table, as used in the system of **FIG. 2**;

FIG. 7 illustrates an example of a vertical and hierarchical data trees, as used in the system of **FIG. 2**;

FIG. 8 is a table illustrating user-determined thresholds, for use in the system of **FIG. 2**; and

5 **FIG. 9** is a flowchart illustrating a method for transferring information between multiple buyers and multiple vendors, in accordance with the system of **FIG. 2**.

10 **DETAILED DESCRIPTION OF
THE PRESENTLY PREFERRED EMBODIMENTS**

15 The present invention relates to a community- or market-wide, multi-contributor, pooled inventory system that enables all licensed parties to have selective access to data elements. The data elements preferably relate to various aspects of a particular industry. In turn, access to the data elements enable the licensed parties to effect specific actions concerning the data elements, such as, for example, automated re-supply, billing, consignment, truck stock management, service, marketing, general communication improvements, etc. The present invention may be managed by one of the market participants or, alternatively, by an independent third party.

20 Shared visibility into product parameters – such as quantities, locations, expiration dates, arrival dates, delivery status, point of origin, etc. – between multiple buyers on one hand and multiple sellers on the other relies on a coordinated and common system between the parties. “Coordinated” in the above phrase means built and maintained to serve particular subsets of relevant data to the respective parties, with features that both add value on either end of the equation (distinctly for buyers and sellers) and provide protection for the parties’ internal data. The coordination of data gathering, storage, sharing, and value-added manipulation between multiple independent buyers and suppliers

(or distributing and receiving entities in the case of a single organization) is the essence of this invention. The preferred embodiment of a coordinator in this invention is the host and ongoing administrator of an electronic repository of data and software tools that together constitute a software application, also known as an application service provider (ASP). "Common," as used above, means available to both the parties, as part of their current (or an easily obtainable) internal system for transmitting, manipulating and viewing information, and based on communication standards supported on both ends of the transaction. The preferred embodiment of a common system for communication is, in this case, the Internet or any similar communication system.

The processes covered by this invention may be grouped into generic features (such as security) and two independent cycles (for buyers and sellers), with several points of intersection. Elements of these cycles – selected features that add value for users of the system by enhancing insight into inventory disposition and related commercial activity – are not new. The invention's innovations lie in the particular processes that make the data valid, comprehensible and useful to parties on opposite ends of a transaction and in the cumulative effect – real-time, shared visibility into inventory at the point of use or sale, forming an industry-wide, multi-party inventory management system.

By enabling the multi-customer collection and pooling of inventory, the present invention permits an entire vertical market of customers having similar interests to take advantage of higher levels of service from an unlimited number of vendors and distributors, including widespread consignment inventory practices.

Furthermore, by pooling data contributions from multiple customers and by allowing vendors to view and interpret specific data as it relates to certain rules of access, the present invention foregoes the need for each individual customer to have a computer connection to each vendor or distributor. Thus, from either the vendor or distributor perspective, the multi-customer pooled data provides insight and enables action with regard to individual customers, but also foregoes the

traditional requirement of having a specific link or intermittent query of each individual customer.

Furthermore, the present invention enables an extension of "just in time" manufacturing practices through to the point of consumption. This increased visibility on product stocking levels enables the participating manufactures to optimize available product across the entire market, to view field agent's trunk supply, to move product throughout the market in order to minimize excess manufacturing, to review consumption of critical supply and to manage customer consignment programs.

To this end, a "many to many" method and apparatus for the syndication of inventory and associated data between two or more parties via a computer system or systems managed by one of the parties or by a third, independent party through an "all parties" licensing arrangement is provided by the present invention. According to the present invention, competitive manufacturers or suppliers of product obtain licensed access to a database which contains continuously updated condition and consumption information on their products provided by the market consumers via barcode readers or like systems. Additionally, the central database managing licensor accepts inventory data from licensees and then assembles, sorts and feeds back a collection of the relevant data to all engaged parties in the arrangement to include product manufactures and their agents, as well as producers, distributors, testers and consumers or users.

Data contribution can also include information from the manufacturer or distributor to the customer on the status of product which is in route to the customer's location, as well as information on pricing, billing, account status, product recalls, marketing and the like. Although commerce can be executed through the system, the present invention is primarily designed to collect and organize data which optimizes the entire commercial process, but is not limited to one element, such as, for example, the product selection or purchase.

To that end, licensing parties might also include other commerce facilitators such as group purchasing organizations and industry-wide communication exchanges (e.g., Internet exchanges). These organizations may license information regarding the continuous flow of product between the customers and the vendors or distributors in order to enable such activities as charge-back programs, volume discounting, contract compliance analysis and the like.

The “many to many” inventory data syndication model, as promulgated by the present invention, is primarily designed to enable multiple common customers of the same groups of vendors or distributors to avoid the requirement of multiple unit of use collection systems and multiple interfaces to vendor order fulfillment systems. Likewise, from a vendor’s or distributor’s perspective, the present invention limits the required number of customer interfaces from one for each customer to one for the entire engaged market. As a result, the present invention pertains to a wide variety of markets. However, it is of particular benefit in markets where full integration and use of standardized product coding and or communication languages is lacking. This absence of standardization may be due to a dearth of industry focus, competitive positions of suppliers or a lack of available technology skills at the customer end. Furthermore, the present invention applies particularly well in markets where the material being produced, sold, distributed, controlled, managed, tracked and/or consumed is subject to one or more of the following characteristics:

- The items are labile in nature or subject to obsolescence;
 - The items can be labeled with incremental information regarding newly revealed characteristics while awaiting consumption, thus essentially changing their identity;
 - The items can be moved between various points of use in order to avoid spoilage and to optimize supply;
 - The items can be part of a consignment inventory arrangement;
- and

- The items may be managed by a central database-type system of syndicated information which is then provided to various contributing and consuming parties via a licensing relationship.

FIG. 1 illustrates a schematic diagram of the current environment of an inventory management system **10**. For purposes of the example shown in **FIG. 1**, it will be assumed that the industry in question concerns the supply and distribution of implanted medical devices. Alternatively, the inventory management system described here may be applicable to other products. Such products include, for example, blood and blood-related components (i.e., plasma, retics, red blood cells, white blood cells, etc.), body organs for transplant (i.e., eyes, kidneys, skin, livers, lungs, hearts, etc.), bone marrow and related components, genetic material (i.e., cells, DNA, RNA, eggs, semen, etc.), limbs, (i.e., fingers, hands, toes, legs, arms, ears, etc.), hair and follicles, implanted and external bodily function support or monitoring devices (i.e., pumps, pacemakers, prosthetics, ocular devices, stents, etc.) and organic compounds (i.e., cloned organisms, cells, organs, animals, etc.). The inventory management system may also include veterinary (i.e., non-human) applications for all the medical items listed above. Additionally, the inventory management system may be directed to non-medical labile or "time-sensitive" products, such as cattle, poultry, raw meat and seafood, prepared meat and seafood, wild animals, dairy products, other non-meat prepared foods, plants, flowers, grain, seeds, water, ice, wine, beer, liquor, lumber, apparel and footwear, home furnishings, seasonal goods, toys, reading materials, computers and electronics, packaged software, appliances, hardware, home improvement supplies, industrial supplies, gases, organic fuels and lubricants (i.e., oil gasoline, etc.) and genetically-altered components.

Referring to **FIG. 1**, users of implantable medical devices **12, 14, 16, 18**, mainly hospitals, order supplies from a plurality of suppliers **20, 22, 24, 26**. The suppliers **20, 22, 24, 26** may sometimes be under contract with the users **12, 14, 16, 18**. Generally, the users **12, 14, 16, 18** will additionally have a storage area **28, 30, 32, 34**. The storage areas **28, 30, 32, 34** preferably store, inventory and

match the products to patients. The storage areas **28, 30, 32, 34** may be an internal department within a particular user, as shown; may be shared between two users (as illustrated by reference numeral **36**); or outsourced to a third party (as illustrated by reference numeral **38**).

5 The third party storage area **38** may even be an independent product supplier offering an additional service. In such a case, the third party supplier **38** may employ agents (as shown by the line referenced by numeral **40**) to deliver the product to the user **18** when ordered. In all cases, however, the user's staff communicates frequently (as shown by the line referenced by numeral **42**) with
10 the supplier **24** regarding the inventory needed at the user's facility. As required, agents **44** may be dispatched to move products to users (as shown by the line referenced by numeral **46**) or between users (as shown by the line referenced by numeral **48**) to address a need or to optimize the late-dated supply of a certain product.

15 In all cases, communication on a continuous basis does not exist between blood suppliers **20, 22, 24, 26** in the users **12, 14, 16, 18** or the blood suppliers **20, 22, 24, 26** concerning the level, type, availability, dating, disposition and other pertinent details of the product.

20 At all relevant points within system **10**, some portion of information regarding the availability, status, disposition, dating and other pertinent details on the blood supply may be available. However, no system links these disparate points of information in an organized, reliable and accessible manner. As a result, significant energy, resources, time and supplies are wasted in the current model.

25 **FIG. 2** illustrates a schematic diagram of one embodiment of an inventory management system **100** of the present invention. For purposes of the example shown in **FIG. 2**, it will be assumed that the industry in question concerns the supply and distribution of implantable medical devices. Alternatively, the inventory management system described here may be applicable to other
30 products. Such products include, for example, blood and blood-related

components (i.e., plasma, retics, red blood cells, white blood cells, etc.), body organs for transplant (i.e., eyes, kidneys, skin, livers, lungs, hearts, etc.), bone marrow and related components, genetic material (i.e., cells, DNA, RNA, eggs, semen, etc.), limbs, (i.e., fingers, hands, toes, legs, arms, ears, etc.), hair and follicles, implanted and external bodily function support or monitoring devices (i.e., pumps, pacemakers, prosthetics, ocular devices, stents, etc.) and organic compounds (i.e., cloned organisms, cells, organs, animals, etc.). The inventory management system may also include veterinary (i.e., non-human) applications for all the medical items listed above. Additionally, the inventory management system may be directed to non-medical labile or "time-sensitive" products, such as cattle, poultry, raw meat and seafood, prepared meat and seafood, wild animals, dairy products, other non-meat prepared foods, plants, flowers, grain, seeds, water, ice, wine, beer, liquor, lumber, apparel and footwear, home furnishings, seasonal goods, toys, reading materials, computers and electronics, packaged software, appliances, hardware, home improvement supplies, industrial supplies, gases, organic fuels and lubricants (i.e., oil gasoline, etc.) and genetically-altered components.

The inventory management system **100** may preferably include a computer algorithm program and software, which may be stored integral with, or remote from, a central database **102**. The computer algorithm program may preferably comprise any program capable of being stored on an electronic medium, such as, for example, RAM or ROM, and permitted to be accessed (and consequently run) by microprocessor (not shown), preferably running integral with, or remote from, the central database **102**. Alternatively, the software running inventory management system **100** may be performed manually by a programmer, electronically programming instructions to the inventory management system **100**, either remotely from a location away from the inventory management system **100**, or via an electronic connection with the inventory management system **100**.

Referring to **FIG. 2**, the embodiment of the inventory management system **100** of the present invention comprises a model and apparatus for the inventory management and distribution of implantable medical devices. In the embodiment shown, key information, such as the status, disposition, availability, price, age, etc. is contained in a single, multi-user, independent location, such as a database **102**. Furthermore, the database **102** may be accessed by all parties appropriately involved in the transaction of each unit of product.

Referring to **FIG. 2**, the fundamental change from the present market picture (i.e., **FIG. 1**) is the addition of the independently maintained database **102**. As seen in **FIG. 1**, the present market picture is a competitive model that does not afford ease of communication between market suppliers or customers concerning the status of the product. This creates waste and excessive effort to communicate effectively regarding the supply.

By contrast, referring to **FIG. 2**, the present invention provides a central point of information **102**, accessible by all (subject to certain rules), without disturbing the existing market structure. There are still suppliers **104**, **106** who compete for users **108**, **110**. Product is still brought to the user's facilities **112**, **114** by shippers **116**, **118**. Suppliers **104**, **106** still manufacture products and hold it in their warehouse locations **122**, **124** awaiting approval to distribute. Some suppliers **104**, **106** may choose to place part of their supply at the hospital on consignment **126**, which is enabled and easily managed through the present invention.

Another element of the model is the proliferation of data access and/or viewing devices **142**, **144**, **146**, **148**, **150**, **152** that enable all parties to see their data on their supply. These devices can be as varied as phones, pages, PDAs, computers, Internet browsers, etc. These devices communicate with the central independent repository **102** via communication links **164**, **166**, **168**, **170**, **172**, **174** – importantly, without need for a specific and proprietary communications protocol; rather, they rely on the standard communications protocol used to connect with this common communications platform (a preferred embodiment is

the Internet). Another change to the market model is the addition of information collection devices (e.g., bar-code scanners) **128, 130, 132, 134, 136, 138, 140**, which are interfaced to a network which is in turn connected to the database via the Internet or other network (e.g., wireless). As indicated in **FIG. 2**, these

5 devices **128, 130, 132, 134, 136, 138, 140** are widely deployed throughout the invention to collect data on a continuous basis.

The use of various data collection devices **128, 130, 132, 134, 136, 138, 140** and data viewing devices **142, 144, 146, 148, 150, 152** by all significant players in the supply chain enables the constant updating of the central

10 independent repository **102**. This system provides critical, and previously unavailable, information to the individuals, who can use the data in a proactive manner to optimize the blood supply.

Although traditional service contracts between suppliers and customers continue to exist in the current invention, the invention enables new parties **154**, e.g., industry analysts, to easily gain a consolidated view of the product status, availability and disposition. In addition, the model allows rules of access to govern the availability of information between market players (i.e. between neighboring hospitals) so that they can support one another's needs. Likewise, the rules of access can permit two affiliated suppliers to view each other's supply

15 status while maintaining as proprietary the sources of that supply **120**.

Finally, although the various suppliers remain independent, the access rules that are a part of the invention can permit all parties to optimize the supply that is in the channel. For example, the invention enables all supplier representatives **116, 118** to use their data retrieval systems **136, 138** to move supply between

20 hospitals (as referenced by lines **156, 158, 160**), while appropriately tracking ownership for payment purposes.

In operation, this invention eliminates the product waste and excessive and laborious communication and product shuffling effort associated with the current market model.

Sub 12

FIG. 3 illustrates the basic function of the present invention. A data collection device **128, 130, 132, 136, 138, 140** acquires information in the form of a code (an example is the alphanumeric code indicated by a barcode). The code is communicated via computer link **182** to a central Product Information Database **200**, which associates product attributes with the alphanumeric code. The Product Information Database **200** is updated by periodic communication via computer link **186** with a plurality of Vendor Product Attributes Databases **204**, maintained separate from the Product Information Database **200** by a plurality of vendors or suppliers. When the Product Information Database **200** can't identify a code, it communicates the problem to the Exception Capture and Reporting Engine **202** to be addressed and corrected. The Product Information Database **200** continuously communicates via computer link **190** with a Central Inventory Data Repository **104**. The difference between the two databases is that the Product Information Database **200** is a record of single-instance product information regarding a plurality of products, and is not modified by exchanges with the Data Collection Device **128, 130, 132, 136, 138, 140**.

The Central Inventory Data Repository **104**, on the other hand, maintains a dynamic record of multiple instances of a single product information code, in order to track product totals.

When a Communications Interface for Formatting and Viewing Data **142, 144, 146, 148, 150, 152** (one embodiment is an Internet browser) requests a data subset, the request goes via computer link **180** to a Data Subset Presentation Engine **206**. According to pre-selected parameters, the Data Subset Presentation Engine **206** acquires data via a communications interface **188** from the Central Inventory Data Repository **104**, and presents the data subset via a communications interface **180** through a Communications Interface for Formatting and Viewing Data **142, 144, 146, 148, 150, 152**.

Referring to **FIG. 9**, a method for transferring information between multiple buyers and multiple vendors is illustrated. In Block **500**, a central node receives various information corresponding to a plurality of products. This information is

preferably transmitted to the node electronically, but may be by any other suitable means providing for the transfer of information. Additionally, the information is preferably sent to the node from a plurality of independent sources. Preferably, these independent sources are suppliers of a particular product (i.e., vendors). For example, a vendor may supply information to the node regarding specific details about the product controlled by vendor, such as, for example, amount of product, size of product, cost of product, etc.

Upon receiving the information, in Block **510**, the node then stores this information in a first database.

In Block **520**, the node then receives a request for information. Preferably, this request may come from at least one user (or, more specifically, would-be-user) of the product stored in the first database. For example, a buyer may inquire to the node as to the status of a particular product.

In Blocks **530** and **540**, the node retrieves the requested information from the first database and posts the information to a second database.

In Block **550**, the node provides access to the second database to a plurality of subscribers. That is, according to a particular subscriber's account, the node allows access to the second database. This method of selective allowance to the database is preferably based on a number of security measures that allow restricted access to certain databases of information. Additional measures include, for example, login names and/or passwords. Thus, if a subscriber is allowed to access a particular database for information relating to a particular product, that subscriber (whether a vendor or a buyer) may be permitted to view the information contained in the second database. In most cases, the subscriber may be the same person or entity as the person or entity making the request for information in Block **520**. However, such is not a requirement, and a subscriber may be different from the requestor. Assuming the subscriber meets the security requirements, the subscriber is permitted access to the second database.

Upon accessing the second database, the subscriber may transact business with a particular vendor or buyer dealing in the product that is the subject of the information contained on the second database. This is shown in Block 560.

What follows is a detailed description of the software components and processes of the system of the present invention. The term "page" as used in the following detailed system description refers to a discrete interface for information presentation or interaction. A single process involving multiple steps may encompass many pages, but not every step requires that a separate page be presented to the user (many steps are carried out internally, without presentation or interaction with the user).

Open Network Model. This invention relies on the participating entities having a common platform of communication (the preferred embodiment for this invention is the Internet).

Security and Access Control. The invention's implementation of data security and user identification is critical to assembling and providing access to specific data subsets, based on each user's relationship to the community or market employing the system. This system component is illustrated in FIG. 4.

1. Log In

1.1. Username and password protection. A coordinator or "host" creates and maintains a data record (preferred embodiment: an electronic database accessible over the Internet) of valid user identification codes (usernames) and user passwords. Unique user passwords, encrypted in the system so that they are unknown even to the host, are critical to this invention, in that they provide the means of delineating relevant tools and bodies of data to be

presented to the user, in exclusion of other tools and data that the user is not authorized to access.

- 1.2. Forced Password Change **340** on first log in. Users are required to create a new password, unlike the current one, any time they log in for the first time with a new or system-issued replacement password. This prevents access by anyone who discovers a user's initial password issued by the system (for example, via e-mail).

The invention uses a database "flag" to determine whether the user has every logged in before and resets this flag whenever a new password is created for the user.

- 1.3. "Module"-level security checking. Modules are discrete features or portions of features deemed sufficiently distinct to warrant independent security protection. A user's access to each module is denied by default unless specifically permitted by the coordinator. Users themselves may select and modify their own roles but may not alter the relationship between any role and any module; this privilege is reserved for the coordinator.

- 1.4. Roles and permissions. Users' roles define their general function, position or "need to know" for purposes of the invention. Roles correspond to the aforementioned security keys, in that they determine which users have access to which modules (system features). Permissions govern which roles have access to which modules. Each user has one or more roles. Each module is accessible by those users whose roles have the appropriate permission.

- 1.5. User identity and security keys **310**. Multiple elements of user's online identity are communicated constantly throughout a user's interaction with the software, determining Application Module Access **320**, Data Subset Access **322**, and rights for Communication With Other System Users **324**. While a user is in

communication with the invention, all user activity is governed by the user's identity and the user's "security key." The system obtains these elements from the Database of User Identities and Security Keys 330 in connection with the username and password. Once the user's username and password are validated against the database and the corresponding security key and user identity are obtained, a "session" with the system may proceed. The user's security key is a general identification grouping that determines whether the user has access to a feature, function, area or page within the application (see Roles and Permissions under Section 2.2). The user's identity is unique to the user but also includes parameters this user shares with others in the same organization (i.e., the identity of Jane Smith, employee of SupplierA Inc., includes elements that identify her uniquely as Jane Smith and generally as an employee of SupplierA Inc.). This provides unique access to data sets such as her password change input section and shared access to the specific data set that this invention reserves for ABC Inc. The combination of security key and user identity determines what the user can access, view, and manipulate within this system. A sample of code for determining and acting on a user's identity and security keys upon arrival at a new page (one embodiment is Active Server Pages, or ASP language, employed largely in the development of Internet-based applications) is as follows:

```
if not IsUserAllowed("ModuleName", ALLOW_VIEW)
then
    response.Redirect "not_allowed.asp"
    response.End
end if
```

In other words, if the role to which a user has been assigned does not having “viewing” permission to a module called ModuleName, then that user is redirected away from the page or feature of the system to which he or she was seeking access.

Passing of this data to the system is at no time visible to or affected by the user: it occurs by virtue of a repeated verification of user identity and security key as stored, temporarily, on the user’s own communication device. The preferred embodiment of the present invention is an encrypted token or cookie, placed on the user’s device by the system, and being automatically deleted upon manual or automatic termination of the user’s session (see Section 2). Direct access to or manipulation of either the security keys or identities by users is not permitted.

A further example is the dynamic, on-the-fly creation of customized data sets according to certain parameters of users’ identities. The preferred embodiment of the present invention uses a Microsoft SQL database. So, for example, a user may be identified partly as having employerID = SupplierA. Because the user’s identity travels with the user throughout a session, available to every new page visited or function executed by the Data Subset Presentation Engine 206, specific, personalized data subsets can be called from the Central Inventory Data Repository 104 simply by using this and other values as constraints on the user’s request. This principle is illustrated in FIG. 5. For example, the following selects from a table inventory the current array of products 612 associated with a user whose employerID = SupplierA, excluding products from SupplierB

614 and SupplierC 616 stored in the same Central Inventory Data Repository 104 where employerID <> (not equal to) SupplierA 610:

```
SELECT
    product_code, product_name, expiration_date,
    quantity
FROM
    inventory
WHERE
    employerID = 2
```

This is a traditional and common way of deriving subsets of data from a database, limiting access to data to those whose identity permits it. The present invention's innovation is to provide the coordination of these security checks and resulting data sets between multiple buyers and multiple sellers.

2. Log Out

2.1. Manual. The preferred implementation under this invention also includes a visible control (screen button) and supporting code for terminating a user's session with the system. Once terminated and inactive, the connection cannot be used by any user to access or manipulate the system or data it contains. Because of the aforementioned constant communication of user identity and security key to the system, no module or component the system or its associated data may be accessed or manipulated outside an active session.

2.2. Automatic based on a time interval. Along with the user's identity and security key, the system in this invention places a time stamp in the token or cookie on the user's communication device. With

each new transmission of a request to the system, it compares the time value to the central system's time value. If the time stamp on the user's device is less than the time value on the central system by a set interval, then the user is presumed to have been inactive since that time and is logged off automatically.

3. Coordinated security of user identities and data.

3.1. Access to user identities and data. The coordinator or host controls access to user identities and related data. Users can manipulate selected data points within their own and affiliated records in the database (e.g., employees at the same company or department), but they cannot alter the composition or permissions associated with various roles or security keys, and they cannot associate any user with any entity or organization outside their own. (For example, a user from one company cannot be associated with any other company not under control of or related to the first; a user within one division of any organization cannot be associated with any other division, except by those user-administrators with control over both divisions' associations.) Only the coordinator of the system has access to and control over users' affiliation in the system database with unassociated organizations.

3.2. The preferred embodiment of this subsystem of user identities and data is a hosted computer-network server, in a secure environment managed either by the main coordinating party or a separate third-party.

4. Communication among parties.

4.1. Messages to trading partner. Preferred embodiment is e-mail message either within the system or from the system to any independent e-mail system (such as Microsoft Outlook), and other

embodiments include fax communication transmitted from the system to any outside fax interface, paging systems, mobile phones, and other wireless communications interfaces. The ability to use the system's communications tool and to reach specific other users of the system depends on a user's identity and security keys.

Buyer's Product Management Cycle: Receive, Monitor, Record Use/Sale, Order. Once granted access, the buyer works with the system in a cycle of receiving goods, monitoring, recording use or sale of items, and ordering new items.

1. Receive

1.1. Add. The system maintains a running total of buyer's inventory by incrementing current totals with the addition of new items. The basic process for submitting items to the system for inclusion in the running total of a buyer's inventory is captured in **FIG. 3**. A Data Collection Device **128, 130, 132, 136, 138, 140** submits a product code for comparison to values in a Product Information Database **200**. Using logic in the Data Subset Presentation Engine **206** (described in greater detail below), the system increments the total quantity record for the identified product in the Central Inventory Data Repository **104**, for later viewing by authorized system participants via a Communications Interface for Formatting/Viewing Data **142, 144, 146, 148, 150, 152**, using presentation logic residing in the Data Subset Presentation Engine **206**.

1.2. Identification of products based on full or partial user-provided input. Users increment their inventory records by first identifying the code of the product they wish to add. For the preferred embodiment of this invention, that code is expressed in barcoded format, read by a Data Collection Device **128, 130, 132, 136, 138,**

140, for example, a barcode scanner. Two problems work against the accuracy and clarity of the records for the parties sharing the data through this system. First, the codes may be expressed or read inconsistently, even for the same product. "H123" and "+H123-" may represent one product, and "H123A" and "H123B" may represent different unit containers of one product (e.g., 1 in the box for "H123A" and 10 in a case for "H123B"), but storing the different values on behalf of that product in the Central Inventory Data Repository **104** would misrepresent the total quantity, making effective management of inventory impossible. For example, a perceived quantity of "0" of product "H123" may simply reflect the data collection device's preference for passing "+H123-" as that product's identifying code to the Product Information Database **200**. The invention protects against this confusion with the measures described below in this section.

1.2.1. Exact match of the user's initial input. The Product Information Database **200** stores values for each unit size of each product within a given marketplace. If the initial code from the Data Collection Device **128, 130, 132, 136, 138, 140** is an exact match of a product ID code in the database, this value is used to update the Central Inventory Data Repository **104**, including the incrementing of total quantity of that item.

1.2.2. Parsing of the code from the Data Collection Device **128, 130, 132, 136, 138, 140**. If no exact match is found for the initial code, the current embodiment of the invention attempts a series of modifications to that code in a bid to find an exact match with some element of a product record in the Product Information Database **200**. For example, the current embodiment of the invention systematically removes characters from the beginning and end of a user-submitted code, such as "+H123-," eventually finding a match

with "H123." The eliminates variation in the identification of the item coded "H123."

5 1.2.3. Multiple matches. Though the Product Information Database **200** enforces uniqueness in product ID codes, the parsing described above may yield multiple matches with records in the Product Information Database **200**. If multiple matches are found, the Data Subset Presentation Engine **206** checks the records from the Product Information Database **200** for identical manufacturer and other item identification, indicating a single product type with different packaging sizes. In this case, the Data Subset Presentation Engine **206** favors the lowest available quantity; it offers the alternatives only when necessary for proper tracking of the lowest tracked unit size (e.g., in the case of management by case, carton, or multiple-item container). In the absence of a positive determination of a single product with multiple pack sizes, the Data Subset Presentation Engine **206** returns all possible options, enabling the user to choose.

10 1.2.4. Automatic determination of product identification requirements. From a comparison of the user-provided product code to a series of user-established preferences for inventory handling (in this embodiment, covering issues such as whether lot number are required for adding a certain product to inventory or the status of the product for consignment purposes), the Data Subset Presentation Engine **206** can selectively request more input from users, to increase the detail of the user's portion of the Central Inventory Data Repository **104**.

20 1.2.5. Storage and modification of mutually visible parameters. A buyer's establishment and upkeep of its portion of the Central Inventory Data Repository **104** creates the shared content at the core of this

invention. Examples include product identification numbers, lot numbers, expiration dates, storage locations, quantities, etc.

1.2.6. Automatic identification of parameters based on analysis of product coding (e.g., determination of expiration date, point of origin, date of manufacturer, etc. from lot number or serial number barcode). The invention incorporates logic in the Data Subset Presentation Engine **206** to derive from various user-provided data other important product parameters. An embodiment of this logic is the following algorithm excerpt:

```
if len(strUPN_unaltered) = 22 then
    if mid(strUPN_unaltered,15,2) = "10" then
        ' lot number delimiter
        strLot = mid(strUPN_unaltered,17)
        strLot = Replace(strLot, "<", "&lt;")
        strLot = Replace(strLot, ">", "&gt;")
    end if
```

This says, if the length of the user's input is 22 characters, and the number "10" occurs in the 15th position in the input, then the following characters is a lot number.

1.2.7. Adding an item to inventory in this invention triggers certain routines to determine if additional user interaction is required to initiate some other process within the system. For instance:

- If an item is being added to a buyer's inventory for the first time, the buyer is given the option of adding details such as the price, par level, internal code, and the necessity for indicating lot number and expiration data on future additions of like products.
- If the item is "consigned" to the buyer by the seller, the Data Subset Presentation Engine **206** can note this fact in the Central

Inventory Data Repository **104**, to trigger functions by the Data Subset Presentation Engine **206** and change the parameters of display to other system participants through their Communications Interface for Formatting and Viewing Data **142**, **144**, **146**, **148**, **150**, **152**. For example, "consigned" status may move a product to a separate Alert or Viewing function for the supplier of the consigned item.

1.3. Exception handling for product identification. If the user-submitted code is not identified by any effort of the Data Subset Presentation Engine **206**.

1.3.1. Initial input not recognized. In this case, the Data Subset Presentation Engine **206** redirects the user to a process that allows the user to submit additional information manually to the Data Subset Presentation Engine **206** (an example in the preferred embodiment is the selection of the product's manufacturer from a list and manual entry via a Data Collection Device **128**, **130**, **132**, **136**, **138**, **140** of a product catalog number).

1.4. Reconcile. To ensure the values for parameters such as quantity, lot number, and expiration date in the inventory system are accurate, the buyer can use the Data Subset Presentation Engine **206** to compare physical inventory to system inventory. In the Reconcile process, the user submits data from Data Collection Device **128**, **130**, **132**, **136**, **138**, **140** to the Product Information Database **200**, which interprets the data. The Central Inventory Data Repository **104** temporarily stores the new data for comparison to existing records in the Central Inventory Data Repository **104**, identifying discrepancies between the physical and virtual inventories and allowing the user to correct those discrepancies through the Data Subset Presentation Engine **206**.

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- 2.2. Par Level Creation and Modification. A Buyer's par levels represent ideal stocking levels. At the par level, supply is neither too low, creating a risk of shortages, nor excessive, representing a strain on capital and storage resources.
- 5 2.3. Alerts. The Data Subset Presentation Engine **206**, acting on continuous comparisons between various values in the Central Inventory Data Repository **104** and user-determined thresholds for differences in those values, automatically sorts alerts, or messages for immediate user attention, into the following types (**FIG. 8**):
 - 10 2.3.1. Highlights. Summaries of the other Alerts groupings – total numbers of various types of Alerts.
 - 2.3.2. Low Stock **410**. Where current quantity \leq par level – (par level \times user's low stock threshold percentage).
 - 15 2.3.3. Overstock **420**. Where current quantity \geq par level + (par level \times user's overstock threshold percentage).
 - 2.3.4. Expired. Where expiration date $<$ today's date.
 - 2.3.5. Nearing Expiration. Where expiration date – user's expiration date threshold expressed in months $<$ today's date.
 - 20 2.3.6. Watch Lists. The relationship between these Alerts ensures that no product is "invisible" to the users on either end of the transaction during the time that it remains "on order," prior to its receipt (see **FIG. 8**).
 - 2.3.6.1. Low Stock Watch List **430**. Where quantity \leq par level - (low stock threshold \times par level) AND quantity + quantity on order \geq par level - (low stock threshold \times par level) AND quantity + quantity on order \leq par level + (over stock threshold \times par level)
 - 25 2.3.6.2. Overstock Watch List **440**. Where quantity \leq par level + (over stock threshold \times par level) AND quantity + quantity on order \geq par level + (over stock threshold \times par level)
 - 30

2.3.6.3. Products on Order **450**. Where quantity > par level - (low stock threshold x par level) AND quantity + quantity on order < par level + (over stock threshold x par level) AND quantity on order > 0

5 2.3.7. Consigned Product Used. Alerts Buyers to the usage of a consigned product (one do not yet own but which has been placed with them for use or sale by the supplier, in anticipation that the use or sale of that item will trigger purchase of the item by the buyer from the supplier).

10 2.4. Search. Subject to the limits established by their individual identities, users may search the Central Inventory Data Repository **104** and Product Information Database **200** using their Communications Interfaces for Viewing and Transmitting Data **142**, **144**, **146**, **148**, **150**, **152**. The Data Subset Presentation Engine **206** interprets and allows manipulation of the results.

15 2.5. Reports. Reports use the Data Subset Presentation Engine **206** to present a view of a data subset to an authorized user.

20 2.5.1. Parameters initially set. Reports with parameters initially set do not require the user to interact with software control in the Data Subset Presentation Engine **206** to see an initial result (this result may be customized subsequently).

25 2.5.2. Parameters set by user through interaction with software. Reports with parameters set by user through interaction with software direct the Data Subset Presentation Engine **206** as to which particular data points the user wishes to see.

2.5.3. Memorized. Any data set presented by the Data Subset Presentation Engine **206** may be saved or "memorized" by the user, for later retrieval.

30 2.6. Hosting of User-Provided Data. This invention relies in many particulars on sharing a single body of information between multiple

buyers and multiple sellers over a common communication platform. However, the preferred embodiment also provides a structure and electronic storage for the internally meaningful data – codes, prices, names, etc. – of participants in the system. The user identity and security key protections ensure that this information is not shared with unauthorized user, though participating organizations may elect to reveal certain data points to certain of their buyers or suppliers.

3. Record Usage/Sale

3.1. Removal. A Data Collection Device **128, 130, 132, 136, 138, 140** passes a code number to the Product Information Database **200** for identification. The identified code is used by the logic in the Data Subset Presentation Engine **206** to decrement the appropriate record in the Central Inventory Data Repository **104**. Product identification from the user-provided code relies on processes described in Sections 1.2 and 1.3 above in the Buyer's cycle.

3.2. Detailed Usage/Sale Records (an embodiment is the present invention's Encounters feature). In addition to submitting codes of products to be removed from the running total of items in inventory, the Detailed Usage/Sale Records component enables the buyers, prompted by logic in the Data Subset Presentation Engine **206** pertaining to use or sale of the products (to whom it was sold, under what conditions, at what discount, with what outcomes, etc.) to use a Communications Interface for Formatting and Viewing Data **142, 144, 146, 148, 150, 152** to supplement the record of the removal in the Central Inventory Data Repository **104**.

3.2.1. Archive of usage records. The invention provides an information storage platform (preferred embodiment: the Central Inventory Data

Repository **104**) for subsequent retrieval of a buyer's usage records.

- 3.3. Consigned product usage and notification. The invention provides tools within the Data Subset Presentation Engine **206** for a buyer to notify a seller about use of and need of replacement for consigned goods through a Communications Interface for Formatting and Viewing Data **142, 144, 146, 148, 150, 152**, along with access controls for transferring transaction details to the intended party (appropriate supplier), exclusive of other suppliers.

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4. Order

- 4.1. Automated from Alerts section. The Low Stock Alert described in Section 2.3.2 allows the buyer to use a Communications Interface for Formatting and Viewing Data **142, 144, 146, 148, 150, 152**, along with functions contained in the Data Subset Presentation Engine **206**, to create orders for entry into other, unrelated systems or for direct transmission, via the Data Subset Presentation Engine **206**, to suppliers. In the preferred embodiment, the user selects "order" across from any line item indicated to be in short supply, then selects a "prepare order worksheet" button to retrieve a record from the Central Inventory Data Repository **104** via the Web browser, detailing the number of products to be ordered (the difference between the user's par level and the current quantity, changeable by the user). Once completed, this order worksheet updates the Central Inventory Data Repository **104** to note that the product is on order. In the preferred embodiment, this status is altered either by the user's adding of this product to his inventory record or by the Reconcile Order or Acknowledge Order function contained in the Data Subset Presentation Engine **206**.
- 4.2. Manual. A manual order combines logic for searching the Product Information Database **200**, storing details in the Central Inventory Data Repository **104**, and communicating those details in the form of an order worksheet to any authorized participants in the system via a Communications Interface for Formatting and Viewing Data **142, 144, 146, 148, 150, 152**.
- 4.3. Standing order management. Standing orders use details from the Central Inventory Data Repository **104** and order-creation logic from the Data Subset Presentation Engine **206** to prepare repeating, identical (but editable) order worksheets for products

presumed to need replenishment in like amounts at regular intervals.

- 4.4. Archive of order data. Order data is retained for later retrieval in the Central Inventory Data Repository 104. The logic for finding and formatting stored order data is housed in the Data Subset Presentation Engine.

Supplier's Product Management Support Cycle: Monitor. In supporting its customers using this invention – performing such tasks as helping a customer avoid shortages, product spoilage, overstocking, uneven stocking levels of key products, etc. – the supplier uses a Communications Interface for Viewing and Transmitting Data 142, 144, 146, 148, 150, 152 to access data from the buyer's portion of the Central Inventory Data Repository 104. The tools used in this support role, launched from the Data Subset Presentation Engine 206, function identically to those used by buyers. The difference is the range of data available to a supplier.

1. Monitor

- 1.1. View. The supplier's access to a broad yet tightly controlled set of buyer data is at the heart of this invention. The supplier sees on his own product at his buyers' location, in real-time, by virtue of a relationship between supplier representatives and buyers, and with the permission of the buyer (granted through selections made through an Internet browser (in the preferred embodiment) in functions stored in the Data Subset Presentation Engine 206, driving modifications in the Central Inventory Data Repository 104). Under no circumstances can one supplier ever view the data or activity of another supplier. The identity and security keys dictate the terms of access through the user's session.

FIG. 6 and 7 – images created from screens of a current embodiment of the invention)

1.1.1. View Customizations – format and content variations. Suppliers have access to controls for two-dimensional data tables, vertical, hierarchical data trees (FIGS. 6 and 7 – images created from screens of a current embodiment of the invention), and other alternatives for customizing their view of permitted data.

1.2. Alerts. As in Section 2.3 above in the **Buyer's Product Management Cycle**, but limited to notices about inventory conditions relative to the supplier's own product lines only. This and all other replication of buyer functionality on the supplier side of the invention is accomplished in this embodiment by separate code in the Data Subset Presentation Engine 206 for the supplier. This code performs at least two security checks and formats data from the Central Inventory Data Repository 104 accordingly: it determines the user type of the requestor, and upon determining a user type of "supplier," determines with which supplier the user is affiliated. Only data pertaining to this supplier is available to the user: he can never see data on another supplier's product, from generic parameters such as descriptions or catalog numbers to specifics such as current quantities, sales dates, prices, expiration dates of stocked product, etc.

1.3. Search. Limited as above by the user's code to data pertaining to his or her organization. In the preferred embodiment (using a Microsoft SQL Server database and the ASP coding language for Internet applications), the dynamic inclusion of a "where" clause (e.g., where manufacturerID = 5), drawn from the user's identity, in any database requests performed on the Central Inventory Data Repository 104 by the Data Subset Presentation Engine 206, limits search results to a user's own organization, while providing real-time visibility into buyer inventory levels and other data.

- 1.4. Reports. Functions as in 2.5 above for the **Buyer's Product Management Cycle**, with available data limited by the user's identity and supplier affiliation.

5 **Supplier's Internal (Field-Based) Product Management Cycle: Receive, Monitor, Use/Distribute, Order.** These features of one preferred embodiment of the system (an inventory system between multiple buyers and multiple sellers of implantable medical devices) pertain to maintenance of a field-based inventory of products by a supplier's sales or service forces. Sometimes called "trunk
10 stock," this inventory is used for product demonstration or as a limited, widely dispersed distribution channel to satisfy urgent buyer needs.

1. Receive

1.1. Add. As in Section 1.1 above in the **Buyer's Product Management Cycle**, but access is limited to the supplier's own
15 product lines. Constrained by a "where" clause that dynamically inserts the supplier-user's supplier (employer) code, the supplier may not call from the Product Information Database 200 or store in the Central Inventory Data Repository 104 any data pertaining to other manufacturer's products.

1.1.1. Identification of products based on full or partial user-provided input, handling of multiple product code matches and unidentified products codes (exceptions). As in Section 1.2 above in the
20 **Buyer's Product Management Cycle**, with access limited to the supplier's own product lines.

1.1.2. Storage of and access to dynamic product parameters from the Central Inventory Data Repository 104 (e.g., quantities, lot numbers expiration dates, par levels, etc.). A supplier may, at its discretion,
25 give its customers visibility into its field-based inventory, using constraints set by the supplier in the Data Subset Presentation
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Engine **206** (for example, giving customers in the Northeastern U.S. access through a Communications Interface for Formatting and Viewing Data **142, 144, 146, 148, 150, 152** for reviewing available inventory of sales and service representatives covering that territory).

1.2. Reconcile. As in Section 1.4 above in the **Buyer's Product Management Cycle**, with access limited to the supplier's own product lines.

1.3. Acknowledge Order. As in Section 1.5 above in the **Buyer's Product Management Cycle**, with access limited to the supplier's own product lines.

2. Monitor

2.1. View. As in Section 2.1 above in the **Buyer's Product Management Cycle**, with access limited to the supplier's own product lines.

2.2. Alerts. As in Section 2.3 above in the **Buyer's Product Management Cycle**, with access limited to the supplier's own product lines and, in one embodiment, the following supplier-specific Alert types.

2.2.1. To Be Returned – Loan/Trade/Exchanged from Customer. Provides a section in the Alerts function of the Data Subset Presentation Engine **206** that retains a record of any product “added” to a supplier's field-based inventory and recorded in the supplier's portion of the Central Inventory Data Repository **104** that must later be replaced for the buyer from whom the product was obtained. The alert is satisfied and disappears when the product is returned to the customer, an event captured during the subsequent removal of a product from the supplier representative's field-based inventory.

- 2.2.2. To Be Received – Bartered/Loaned to Customer. Provides a section in the Alerts function of the Data Subset Presentation Engine **206** that retains a record of any product “removed” from a supplier’s field-based inventory and recorded in the supplier’s portion of the Central Inventory Data Repository **104** that must later be recovered from or replaced by the buyer who received the product. The alert is satisfied and disappears when the product is retrieved from the customer, an event captured during the subsequent addition of a product to the supplier representative’s field-based inventory.
 - 2.3. Search. As in Section 2.4 above in the **Buyer’s Product Management Cycle**, with access limited to the supplier’s own product lines.
 - 2.4. Reports. As in Section 2.5 above in the **Buyer’s Product Management Cycle**, with access limited to the supplier’s own product lines.
3. Record Usage/Sale
 - 3.1. Removal. As in Section 3.1 above in the **Buyer’s Product Management Cycle**, with access limited to the supplier’s own product lines.
 - 3.2. Detailed Usage/Sale Records (an embodiment is the present invention’s Sales Disposition feature). As in Section 3.2 above in the **Buyer’s Product Management Cycle**, with access limited to the supplier’s own product lines.
4. Order
 - 4.1. Automated from Alerts section. As in Section 4.1 above in the **Buyer’s Product Management Cycle**, with access limited to the supplier’s own product lines.

- 4.2. Manual. As in Section 4.2 above in the **Buyer's Product Management Cycle**, with access limited to the supplier's own product lines.
- 4.3. Standing order management. As in Section 4.3 above in the **Buyer's Product Management Cycle**, with access limited to the supplier's own product lines.
- 4.4. Archive of order data. As in Section 4.4 above in the **Buyer's Product Management Cycle**, with access limited to the supplier's own product lines.

Intermediary's (Coordinator's) Management Cycle: Setup, Review, Resolve.

The system coordinator maintains a series of controls over data relationships between the participating buyers and sellers, maintains the accuracy and integrity of data in the Product Information Database 200 and Central Inventory Data Repository 104, and assigns and secures the identities, roles, and permissions of system users, which are stored in the Central Inventory Data Repository 104.

1. Setup.

- 1.1. Creating links for shared visibility. Certain logic in the Data Subset Presentation Engine 206 relies on coded relationships between parties to determine access to information. One example in the present embodiment may be access by a user within one department of an organization to the data records regarding inventory or personnel of another department in the same organization. Another might be real-time access, via a Communications Interface for Formatting and Viewing Data 142, 144, 146, 148, 150, 152, to buyer inventory data in the Central Inventory Data Repository 104 for the representative of a supplier to that buyer. A preferred embodiment of security for these

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restrictions is the access security described above in the **Security and Access Control** section, in addition to a system for encryption (Secure Socket Layer is an embodiment) of data traveling across a common communications system (e.g., the Internet).

5 2. Review. A preferred embodiment of the invention provides a dedicated interface for the coordinating party or intermediary, with logic and controls residing in the Data Subset Presentation Engine **206**. The interface provides broad access to the Central Inventory Data Repository **104** and Product Information Database **200** for the coordinator and its

10 representatives, subject to password protection and security key checking. In the preferred embodiment, these passwords are encrypted so as not to be human readable, and therefore unknown to all users but their owner.

SA7 3. Resolve. In addition to simple "viewing" access, the preferred embodiment of this invention provides tools within the Data Subset Presentation Engine **206** for the coordinator's representatives to resolve data issues and maintain and modify both the Central Inventory Data Repository **104** and the Product Information Database **200**. These issues includes but are not limited to correcting erroneous product data, clearing passwords, altering database structure in the Product Information

15 Database **200** or logical structure in the Data Subset Presentation Engine **206**, and modifying links between participants in the system , which are then stored in the Central Inventory Data Repository **104** to be referenced by logic residing in the Data Subset Presentation Engine **206**.

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25 It should be appreciated that the embodiments described above are to be considered in all respects only illustrative and not restrictive. The scope of the invention is indicated by the following claims rather than by the foregoing description. All changes that come within the meaning and range of equivalents are to be embraced within their scope.